CHANGING WHAT'S POSSIBLE

U.S. DEPARTMENT OF ENERGY

Ultra-Fast-Triggered Semiconductor Devices for Enhanced System Resiliency

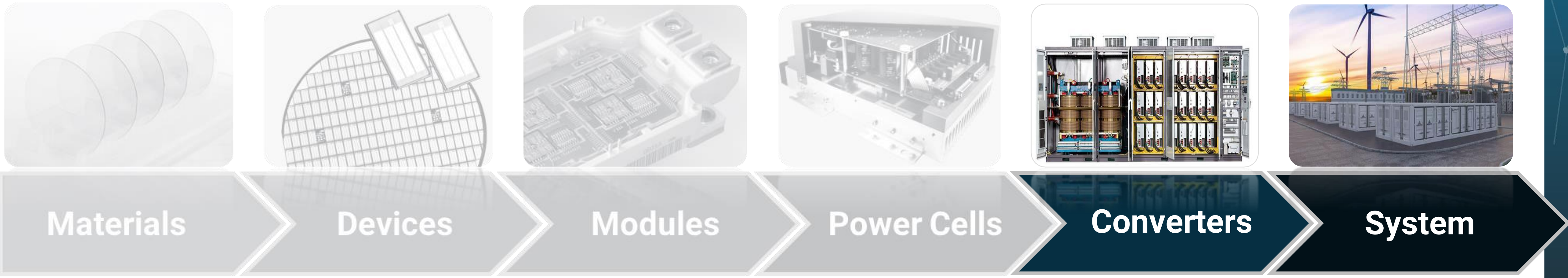
New Program Development Workshop

Day 2 Breakout Sessions

- System Impact

System Impact

CHANGING WHAT'S POSSIBLE



Power Grid

Microgrids

Transportation PDS

Nano-... Pico- ... Femto-... grids

Day 2 Discussion

What are benefits of better temporal performance (slew-rates VS switching speed VS turn on/off delay, etc.), higher current and voltage ratings, as specified by proposed targets for devices and/or modules for system-level performance, reliability, and resilience? (keep in mind potential future power distribution systems)

- What would integrated self-protection offer to protect power electronic-based equipment relative to traditional grid equipment?
- Impact on grid resiliency?
- Would such advances be relevant only for the conventional 60 Hz-based grid, or DC, or high-frequency grid, or one that is voltage- and frequency- agnostic?
- Are there other opportunities for impact (microgrids, EVs, electric aviation, converters for solar or wind power, data centers and other power distribution systems) better, and if so, how?

What are possible advancements in system-level power converters featuring triggering that is unconstrained by wires

- Are there any clear advantages of cascading and/or paralleling devices vs power modules vs power cells as done today for modular converter topologies?
- What could be new approaches to mitigating EMI and how can new mitigation techniques be quantified and verified using testbeds?
- Is completely decoupled control from the power stage (i.e. optics utilized for triggering, sensing, monitoring, etc.) necessary for increased reliability/resilience of future power converters and systems? What are the biggest barriers?
- Are new sensing options necessary (possibly also unconstrained by wires)?

CHANGING WHAT'S POSSIBLE

What transformational grid control/architecture approaches could be enabled by these innovations?

- Active protection (MOV/surge arrestors) integrated into control architecture vs. an add on (i.e. separate breakers)
- Better transient protection (ride-through capabilities)
- Re-configurability

What system level benefits could be realized specifically from optical control/triggering at various levels of integration?

- What additional developments are necessary? What additional costs/risks would be incurred at a system level (and are the benefits worth it)?
- EMI mitigation
- Hot-swapability (resilience impact)?
- Re-configurability

What is minimum demonstration level that shows the advantages of a technology developed in this potential program for a given system?
And what would such a testbed/experiment look like?

- This could be demonstration of improved EMI immunity for example, or improved efficiency/lower losses/better reliability (lower voltage stress) or others.
- Perhaps demonstration of novel capability – fast, efficient bidirectional switch for fast protection or reconfiguration (i.e., bypass at a die-level, power module-level, power cell-level, etc.), or improved ride-through capability for power electronics converters?

CHANGING WHAT'S POSSIBLE

What other system-level impact should we consider?